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PORTO RICO AGRICULTURAL EXPERIMENT STATION.

D. W. MAY, Special Agent in Charge.

ANNUAL REPORT

OF THE

PORTO RICO

AGRICULTURAL EXPERIMENT STATION

FOR 1906.

UNDER THE SUPERVISION OF

OFFICE OF EXPERIMENT STATIONS.

U. S. DEPARTMENT OF AGRICULTURE.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations, United States Department of Agriculture.]

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LETTER OF TRANSMITTAL.

PORTO RICO AGRICULTURAL EXPERIMENT STATION,
Mayaguez, P. R., February 15, 1907.

SIR: I have the honor to transmit herewith and recommend for publication the Annual Report of the Porto Rico Agricultural Experiment Station for the fiscal year 1906.

Respectfully,

D. W. MAY,
Special Agent in Charge.

DR. A. C. TRUE,
*Director Office of Experiment Stations,
U. S. Department of Agriculture, Washington, D. C.*

Publication recommended.

A. C. TRUE, *Director.*

Publication authorized.

JAMES WILSON,
Secretary of Agriculture.

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ANNUAL REPORT OF THE PORTO RICO AGRICULTURAL EXPERIMENT STATION FOR 1906.^a

SUMMARY OF INVESTIGATIONS.

By D. W. MAY, *Special Agent in Charge.*

INTRODUCTION.

The progress of agriculture in Porto Rico, with which the experiment station has been connected, has been decidedly marked during the year. This has been due to various causes. First should be mentioned the improvement in agricultural practice made by the native planters of Porto Rico. They are studying their soils, their crops, and the scientific progress of their business as exemplified by the work of the experiment stations. A decided increase in the interest of the work of their own station can be noticed, and a growing desire for the reports and a personal interest in the work itself. It is impossible for the station to reach all classes of the native inhabitants, but in every community there are found progressive planters who are taking up improved agriculture and are also imparting instruction to their neighbors. It is very encouraging to see intelligent planters who read and study facts imparting information to the small farmers and peons of their localities. Another factor that is having a great influence in the agricultural development of the island is the influx of planters from the United States, who are going in especially for fruit growing. These men come to the island for the purpose of making it their home, and their operations redound to the permanent prosperity of the island by reason of the fact that they improve their lands and greatly increase their productive capacity, and at the same time the profits arising from their efforts are reinvested here. A third factor, and a large one, that is working for the quick development of Porto Rico is the larger corporations that are locating here for the development of tropical industries. The first of these were interested in the production of sugar; their operations are evident in the great change that has come over this

^a This is the sixth annual report of this station. Previous reports will be found in Annual Reports of the Office of Experiment Stations, 1901, pp. 381-415; 1902, pp. 331-357; 1903, pp. 419-468; 1904, pp. 383-424; and Office of Experiment Stations Bulletin 171. A preliminary report on the agricultural resources and capabilities of Porto Rico was published as House Document 171, Fifty-sixth Congress, second session.

production since the American occupation. The central factory system has supplanted the small mills with their open kettles and low extraction. These large "centrals" consume the cane grown in distances of 40 to 50 miles, and their operation has resulted in the abandonment of many small mills that now stand idle in the fields. The large centrals purchase the greater amount of their cane from the planters, or else manufacture the sugar on a percentage basis. The small growers find it more profitable to dispose of their cane in this way than to grind it in their small mills of low capacity. In addition to grinding cane of others, the large centrals are growing more or less cane, for the larger part on leased land. Such plantings are usually carried out under the best conditions, taking advantage of the more modern aids of science. This has a good effect upon the various communities in which such plantings are made by reason of the fact that many planters in the neighborhood watch the results and take advantage of the improved methods demonstrated.

The one crop that has made the greatest advances during the year under consideration is tobacco. There has been a decided improvement in the quality as well as the quantity of this product. The improvement of the quality of the Porto Rican leaf has called the attention of capitalists to the possibilities of this crop in the island. Corporations backed by capital have come in for the purpose of not only growing tobaccos, but of manufacturing them, taking advantage of the plentiful supply of cheap labor abounding here. Many acres, especially in the valleys of the interior, have been put under cultivation and prices of lands adapted to tobacco growing have increased enormously. Large factories have been erected in San Juan, Bayamon, and Caguas, employing hundreds of people. These large companies are not only planting tobaccos, but are buying much more from the small cultivators. A growing practice is for the handlers to buy the crop in the field from the smaller growers, curing and fermenting the plants themselves under the best scientific methods.

The coffee industry, which is the support of the larger number of the inhabitants of the island, has shown some improvement, brought about by the reestablishment of the plantations destroyed by the hurricane of 1899, together with a favorable crop year. A small amount of foreign capital has been invested in coffee plantations, but such investments are not as a rule being sought. Many of the plantations are heavily mortgaged, and such changes as are taking place in the holdings of such properties as a rule result from the foreclosures of these deeds of trust.

The plantings of fruits have been very rapidly extended, especially with citrus fruits and pineapples. These plantings are made almost altogether with foreign capital, and by people from the States, especially the Florida planters. From the results obtained in groves

of citrus fruits now coming into bearing, there is no doubt that very fine fruits of this class can be produced here. There is much yet to be learned in regard to methods of production, especially looking to the matter of decreasing the expense of bringing a grove into bearing. Shipping facilities also need to be much improved in order to put this fruit into the New York market with the minimum loss. Porto Rico has demonstrated the fact that it is peculiarly adapted to the production of the pineapple, and very fine luscious fruits can be grown here at a very low cost. Several million plants have been set during the year, mainly of imported slips of the Red Spanish variety from Cuba and Florida. The planting of the large native pine called Cabezona has also been greatly extended. While the larger part of this variety is canned, some successful shipments have been made to the New York market.

There has been a decided improvement with a number of other crops which will be noted under their separate heads. The work of the experiment station has been continued along the lines stated in the previous report. The demands have been great and in many cases urgent to expand the work, but the present income and resources will not justify the outlay necessary. The income for the station for the year has not increased materially, consisting, as in the previous year, of the Federal appropriation of \$15,000 and the receipts from the sale of products, the latter fund showing a small increase. Efforts were made to secure an additional appropriation from the insular legislature, but, owing to the limited resources of the island and heavy demands of the various local departments of the government, nothing was secured. While, in the writer's opinion, the experiment station is the source from which the improvement of the agricultural conditions will come, the economic situation of the island is such that certain other affairs are considered to be more urgent by the authorities. The anæmic disease prevailing among the inhabitants of the interior requires large appropriations at the present time to carry out the very efficient control remedies developed since the American occupation. Again, the illiteracy prevailing on the island has made demands very strongly in favor of educational work.

It is necessary that the income of this station be increased, and it is desirable that the Federal appropriation be augmented by extending the appropriations under the Adams Act, thereby putting the station on a basis similar to that of the stations in the States. The cost of operating a station in the Tropics is greater than in the Temperate Zone, freight rates are higher for all supplies, it is necessary to pay higher salaries in order to retain men in isolated places and under new and trying conditions, and the cost of cultivation of land is higher, owing to the continuous growing season and the rank spread

of vegetation. Again, the questions confronting the tropical stations are greater for several reasons than those in the Temperate Zone: there is more pioneer work to be done and there are many more problems to be worked out by reason of the fact that experimental work in the Tropics is comparatively new and stations are few and far between.

Mr. W. V. Tower has been added to the staff as entomologist and plant pathologist during the year. It is very desirable to add a chemist to the station and to fit up a chemical laboratory. This is a very urgent need if certain lines of work are continued and if other necessary experiments are undertaken. Owing to the establishment of other stations in Spanish-speaking countries and to the demand of large corporations in the Tropics for trained men as managers, the station should be in a position to pay better salaries and to hold men by being able to offer adequate inducements when they are solicited to go elsewhere.

FARM ENGINEERING.

The condition of the experiment station farm is being continually improved, as means will allow, by building roads, drains, irrigation ditches, and fences. The road running through the farm has been graveled, and another road is under construction into a valley where the operations of the station are now being extended.

The condition of the soils of the station has been greatly improved by tile drainage, and further drains are being laid from time to time as means will allow. Great interest has been taken by our planters in the drainage operations at the station, as we have the only tile mill in the island and are pioneers in this work. Heretofore surface drains have been constructed yearly at great expense. The station has sold tile to several planters for tiling their land and is encouraging this whenever possible. The municipality of Mayaguez allows the station to manufacture tile without paying the usual license fees, under agreement that this shall cease whenever private parties undertake their manufacture. Many acres of very valuable land can be reclaimed in the island by drainage, not only those soils that are too wet for profitable crops, but others in the drier sections that are alkaline. An area of soil on the experiment station farm that is now yielding the largest crops as a result of drainage has heretofore been worthless except for grass, because of the very large amounts of water it contained.

Experiments are being carried out in cement construction, especially in the making of fence posts. The station was fenced about three years ago, and already a great many of the posts have been replaced. Where there are so many wood-eating insects as in the Tropics, wood

construction should be supplanted by other materials where it is possible. The cement posts made by certain methods are proving very satisfactory. A post 4 by 4 inches at the base and 3 by 4 inches at the top can be made for 20 cents, and at this price proves far cheaper than wood posts.

A great many inquiries are made of the station regarding pumping and other machinery, and such questions are taken up as far as our time and ability will allow. In the drier sections of the island some very productive lands are being brought under cultivation by means of irrigation plants. Water is found from 20 to 80 feet below the surface and is raised by pumps of various descriptions. As this work is largely of a pioneer nature, it is very important that efforts of the planters be directed in the methods of bringing water to the surface and also in the improvement of the condition of the soils brought about by eliminating alkali.

LIVE STOCK.

There is great room for improvement in the various classes of live stock in Porto Rico. Very little pure-bred stock has been imported since the time of the early Spanish discoverers, and the result is that there has been very little improvement in the quality of the animals.

From the results reached at the experiment station and on the plantations, there seems no doubt that improved animals of the various breeds can be imported and successfully acclimated. There is also no doubt that the breeders can greatly improve their animals and obtain greater profits by the wise importation of new blood. Certain points, however, must be observed in acclimating animals from the Temperate Zone, or losses will occur.

The horse of Porto Rico is small but wiry. Some of them are very handsome and of great endurance, but in the States animals of the size common here would be classed as ponies. They are especially adapted for riding purposes and go the easy gaits very readily.

In importing horses into the island those breeds that are inclined to fleshiness should be avoided; a better type is the medium-sized lighter specimens of the standard bred or trotting horse and the American saddle-bred horse. Moreover, this type crosses better with the native animals, as they are nearer the same conformation. Even with these animals, however, in any extensive breeding operations monstrosities occur; that is, animals not well proportioned in their various parts.

While the importation of pure-bred animals from the States means a great deal for the improvement of the native stock, it should, at the same time, be borne in mind by our planters that great improvement

can also be reached by selecting their breeding animals with more care. This is a point that has been too greatly neglected in the past.

Many of the native cattle, considering the lack of care in breeding, are excellent individuals. The first requirement of the cattle of the island has been for work animals, and the beef and milk functions have been disregarded in any scheme of improvement. The animals, when they mature, which is rather late, make splendid work oxen on the cane plantations. To improve the race for beef or for milk production the shortest way is to import pure-bred bulls.

Imported animals should be kept in stables and fed cut grass, or, at least, should be kept in small lots well shaded until they become thoroughly acclimated. The second generation will probably be found as well acclimated as the native race, but animals brought from the States will not thrive if allowed to run in the hot sun and to have only the coarse grasses usually obtainable.

There is a difference of opinion as to whether tick fever exists in Porto Rico. From experiments made several years ago by the Bureau of Animal Industry of the United States Department of Agriculture, Washington,^a the conclusion was reached that this disease prevailed here. A veterinarian who has been on the island since the American occupation stated to the writer that it did not prevail. If it does it is not in a virulent form, or else our cattle are very immune to it. The station has had some 50 head of imported cattle from the States, all from north of the quarantine line. Of these three head were inoculated against tick fever; the others were not. While these animals were infested with ticks from the time of their arrival, there were no evidences of tick fever. Within ten days after arrival 200 ticks were taken from a 2-year-old Holstein cow, yet she showed no evidence of tick fever. However, all the animals at the station were well cared for and fed a plentiful supply of green grass at all times. Under such circumstances conditions are much more favorable than where animals are turned out in pastures without having special care. While the indications so far are that animals can be brought from the States and safely acclimated without being inoculated against tick fever, it is strongly advised that they be kept in places sheltered from the sun and be fed a plentiful supply of succulent grasses.

Pigs, turkeys, geese, ducks, and chickens have been acclimated without any serious losses at the station. The hatching of poultry, both under hens and in the incubators, has been carried on during the dry season and has been fairly successful. During the rainy season heavy losses of young chickens have been reported from several sections of the island. Breeders are advised to confine their hatching operations to the dry season for fowls and to properly protect them from the rains, and especially the damp grasses.

^a U. S. Dept. Agr., Bureau of Animal Industry Rpt. 1900, pp. 29, 426.

TOBACCO.

The station is not located in a tobacco-growing section. The soils are extremely heavy and the rainfall great. However, some experiments are being carried on, especially with the White Burley manufacturing tobacco grown in Kentucky. This tobacco grows very vigorously and produces very heavy yields. The crop brings locally about $12\frac{1}{2}$ cents per pound, which is a very fair average for this variety. It is used by small local factories in making the low grade of cigars and also for manufacturing a chewing tobacco. Samples were submitted to several companies located in different sections of the island and seed were also sent them for trial. The manager of one of the largest companies stated that he thought it would make a good binder for cigars.

An extended scientific study of tobacco production in Porto Rico would be of great value at this time. Such work could be carried on at a minimum cost in cooperation with the companies now producing this crop. The services of a scientifically trained expert are necessary and he should devote his entire time to the work. The results reported in Bulletin 5 of this station on tobacco growing in the island have been very favorably received by our planters and the bulletin has been in great demand. Upon this as a basis further work needs to be carried out not only in the growing of tobacco but especially in the curing and fermentation of the product.

COFFEE.

A detailed account of the experiments with coffee during the year will be found in the report of the expert in charge of this work (p. 29). This has been a continuation of the methods of culture, the fertilization of the trees, and the introduction of foreign coffees. The coffees of Porto Rico have never been fertilized and more attention has been paid to this matter in our experimental work. The coffee tree lends itself readily to improvement by fertilizing the soils, and this crop in the island has decreased more in quantity than it has deteriorated in quality, so that the first real improvement in this product depends upon properly fertilizing the trees. By observing the enormous crop of berries carried by the trees this season it is readily apparent that such a condition can not continue without adding something to the soil. As many of these heavy crops have been taken from most of the trees for a number of years, it is not hard to determine the reason for the low yields of some plantations compared with former seasons.

During the coming year several more of the imported coffees at the experiment station, including the higher priced Javas, will come into bearing. These introduced varieties will be tested by experts

and a convention of the coffee growers will be called for the purpose of considering the question of changing from growing the Porto Rican coffee to that of growing those coffees that bring the highest prices in the United States markets. The Porto Rican coffee is considered the highest type of after-dinner coffee and is much relished and brings the highest price in the Latin countries of Europe. Many efforts have been made to introduce this coffee into the United States, but without much success. The question arises whether it would be better to continue the attempts to teach the coffee-drinking public of the States to appreciate the peculiar flavor of the Porto Rican berry or whether it would be easier and a shorter method to grow the coffees that they already prefer and for which they now pay the highest prices.

SUGAR CANE.

The planting of sugar cane in the island has been largely increased during the year. These plantings are being extended almost altogether in the low ground skirting the coast line. They are extending, however, among the first range of low hills, and in sections where the rainfall is abundant and the soil fairly fertile very good canes are produced on such lands. The "central system" is growing and new mills of large capacity have been installed, while those already established have increased their machinery. Several lines of experiment should be carried out with cane, but as this crop is an expensive one to deal with and the funds of the station are limited much cannot be undertaken. The station is planting some improved canes of the island and has also introduced the most promising canes of the British department of agriculture at Barbados, kindly sent by Sir Daniel Morris, commissioner in charge. It is estimated by the British department that the yields from these improved canes have increased the output of sugar on the same area about 25 per cent; doubtless an equal increase can be obtained by planting improved canes in Porto Rico. A collection of the best canes from experiments carried on by the Louisiana Station at Audubon Park have been very kindly sent by Prof. R. E. Blouin. Some of these canes have proved very good indeed for Porto Rican conditions, and a number of them, and also other canes, have been sent out to representative planters in various sections for further tests. The proper fertilization of cane each planter must study for himself, as there is quite a variation in both the chemical and physical composition of the soils planted to this crop. A scheme for testing the requirements of the cane by a system of twentieth-acre plats has been outlined by the station and a number of planters in different sections of the island have taken it up and are making an extended study of their soil requirements. A

number of the more progressive planters have a small portion of their estates devoted to experiments in cane production, it proving of great interest and value.

COTTON.

It has been demonstrated that Sea Island cotton can be grown in Porto Rico, but the extension of this crop is not making much progress. It is a plant that has grown here from the earliest times; in fact, cotton is supposed to be indigenous to the island, but it is a crop that has never appealed to the people, as there have been others that bring larger money returns. There is no doubt, however, that many of the smaller farmers can make this a very profitable industry, especially as they can employ the women and children of their families in its production. It is a crop, however, that needs fertilizers to get adequate returns, and not until our planters learn the proper use of fertilizing materials can they expect a very large income from cotton growing.

There is no boll weevil in Porto Rico, and compared with the Southern States the island is comparatively well off in its freedom from insect enemies of this plant. The cotton caterpillar is the only serious menace, and this insect can be kept in check by well-known means, provided the planter is vigilant and ready to apply his remedies when the insect comes. The cotton plant grows readily in all sections of the island, but not all sections are adapted to its profitable production. At the experiment station quite a number of experiments have been carried out with cotton in the use of fertilizers and the trial of different cottons from other countries and systems of cultivation. While the plant grows readily here, it can not be recommended, for the reason that our heavy rainfall, extending through the greater part of the island, is not conducive to the ripening of the bolls, or to their gathering and curing. Rainy weather is very apt to set in and ruin the crop, but in many sections where dry spells occur cotton can be planted during the rainy season to ripen during the dry.

RICE.

The largest importation of foodstuff in Porto Rico still consists of rice, which comes from the port of New Orleans. There is some extension of rice growing in the island upon the higher lands; practically no irrigated rice is produced. Many more acres of low ground are being put under irrigation every year and devoted to cane growing. When it is necessary to rotate this ground, or when there is a decrease in the present price of sugar, these lands will probably be devoted to growing rice, for which they are well adapted. From ex-

periments made at the station with a number of varieties, it was found that lowland rices flourish in Porto Rico. When certain economic forces work around, Porto Rico will probably be an exporter of this staple. Although labor is plentiful and cheap, profitable rice growing must be carried out largely with the use of machinery, following the methods obtaining in Louisiana and Texas.

FORAGE CROPS.

The principal forage crops of Porto Rico are malojillo and Guinea grasses. These are very rank growing and nutritious grasses, the former growing on the lowlands and the latter on the foothills and even on the mountain sides. It does not seem probable that grasses superior to these two for forage purposes can be introduced. Some experiments have been made in testing lawn grasses, of which Bermuda and grama have succeeded. Bluegrass thrives vigorously for a time, but soon dies out. A number of leguminous forage crops have been under trial as producers of forage and also for restoring nitrogen in the soil. Among these the cowpea is the more promising, making a very rapid growth and producing large amounts of forage. Moreover, this is a plant that not only adds nitrogen to the soil, but very greatly improves the physical condition. No serious insect or fungus pests have developed, and this crop is recommended for extended plantings over the island. The shelled bean may be prepared in a number of ways, and is a very nutritious article of human food. The laborers at the station are growing cowpeas in place of their native bean because of the fact that the yields are much larger in amount of food. The Florida beggarweed in the experimental plats made only a fair growth the first crop, but the second and third crops were very tall, thick, and rank. This is recommended as a soil renovator and also as a forage crop. Velvet beans make a fair growth and seem free from disease; they would doubtless do much better in sandy sections. Alfalfa grows well at the station, and may be cut every six weeks or two months. It is doubtful, however, if it is a profitable crop in a region of heavy rainfall like this. The malojillo and other grasses grow more rapidly during the rainy season, and it requires a great deal of work to keep the alfalfa clean. It is probable that this would be a profitable crop for drier sections and where irrigation is practiced. While the yields here are good, the labor necessary to keeping the crop from being choked out is very great. Some twelve varieties of pigeon peas, locally called "gandules," are under trial at the station. The seed came from India, and among them are some varieties that are superior to the gandule now grown in the island. This pea is grown extensively in some sections, and adds very largely to the food supply of the people. Of the seed of the

new varieties grown at the station, a lot has been sent out to different sections for trial. It is hoped to secure varieties that will produce a larger amount of shelled peas. Experiments are also under way with this plant as shade for pineapples and for young orange trees in the earlier stages of their growth. The plant grows from 5 to 8 feet high, and besides affording shade also stores nitrogen. The station is also growing and sending out among the planters a large white bean known as "sword bean." This is a very hardy plant, and will grow even in sod with rank-growing grasses. It has been planted in malojillo grass with success. In such cases it makes a better balanced mixture for hay or green forage, and also improves the soil to such an extent as to increase the crop of malojillo. It is a plant well worthy of more extended cultivation. Besides the introduction of new legumes, some of the more promising native ones are being bred for the purpose of increasing their productivity.

FIBER INVESTIGATIONS.

The experiments with fiber plants are being continued and a number have been sent to Paterson, N. J., for extraction. A machine has lately been devised that will easily handle the maguey. A shipment was recently made to Paterson of maguey leaves for trial. The machine cleaned them well and the fiber was reported to be of very good quality. However, as the yields were comparatively small as compared with sisal, it is still recommended that the latter be propagated instead of the native maguey. Of the various fibers, sisal promises by far the greater returns under Porto Rican conditions. In cooperation with the insular government several thousand plants have been imported and planted. Funds are available under an insular appropriation for securing a much larger supply, and 100,000 more have just been imported. It is hoped to secure a great number of sisal slips as soon as possible in order to put the industry upon a commercial footing in Porto Rico. While other fibers, as maguey, sansevieria, and abaca, will grow in favored sections of the island, the yields are not to be compared with those obtained from sisal. Ramie grows well at the station on heavy clay soils in a damp situation. A plat of this fiber has yielded continuous cuttings for several years and remains healthy and vigorous.

A great many palm-fiber hats are made in Porto Rico, giving employment to many women and children in the weaving. A firm has recently established factories at Aguadilla, Mayaguez, and Cabo Rojo, employing several hundred women in the manufacture of Panama hats. The fiber is imported from Central and South America in the raw state and made up in Porto Rico for shipment to the States. Labor of this class is plentiful and cheap in the island, and it is very

desirable that the raw material be produced here in sufficient quantity to supply the demand. The station has a few plants of the jipa-japa palm under experiment, and from the results reached it will grow readily in the island. At the request of Governor Winthrop efforts are now being made to import this palm for distribution in different sections where hats are made, so that the weavers may be provided at all times with a plentiful supply of raw material at hand.

FORESTRY INVESTIGATIONS.

A great deal of the uplands in Porto Rico have been deforested and many valuable woods destroyed. This has been done largely for the purpose of obtaining charcoal, and the value of this product has been in no way commensurate with the values that could have been obtained had the trees been allowed to reach maturity. One of the more important lines of agricultural work in Porto Rico is that of reforesting these areas. About three years ago the experiment station planted one of these barren hills to the various economic trees of the island, as well as some imported from other tropical lands. With the exception of the eucalyptus, none of these trees have made a satisfactory growth upon this hill. Where the conditions are poor, but typical of such areas, it has been found necessary to change the procedure in reforesting this plat, and bananas and various leguminous trees of the island and other tropical countries are now being planted. Nature, in reforesting an area, sends up first a growth of plants that are of little value from an economic standpoint, but these seem to pave the way for the growth of more valuable trees and shrubs. The station experiments indicate that in growing economic plants in the Tropics more attention must be given to the questions of shade and wind-breaks. (See p. 21.) Not only is this true of certain fruits, as the orange, but also of hardwood trees. After the growth of the bananas and the softwood legumes has reached a stage where they afford wind-breaks and a certain amount of shade other trees will be planted.

MISCELLANEOUS NOTES.

The station has carried on cooperative work with the insular government in the introduction of fibers and the enforcement of the fertilizer and plant inspection laws. Some work has been carried on with different bureaus of the United States Department of Agriculture. The station is also cooperating with different planters in several sections of the island in the introduction of new economic crops and in the use of fertilizers. In the introduction of new crops, the station furnishes the plants only, supervising the work and making notes on the progress. In fertilizer experiments with planters the

station furnishes the fertilizers and plans the work, and members of the staff visit it from time to time and take notes. Such demonstration work is the best means for reaching a great many of our planters with improved methods. Agriculture in the island is in a primitive condition, and field demonstration proves the most effective means of instruction. Travel during the year has been confined to the island and many sections have been visited by the several members of the station staff. Visits from plantation to plantation have been made and demonstrations carried on in spraying, budding, fertilizing, and laying off farms.

The station is in urgent need of more funds and should be placed on a footing to receive the income granted the State stations under the Adams Act. A laboratory should be fitted up and a chemist added to the staff before the work in certain lines can be carried further. Moreover, it is highly desirable that more instruction be given planters in regard to the needs of their soils and their fertilization.

REPORT OF THE HORTICULTURIST.

By H. C. HENRICKSEN.

As most of the horticultural experiments now under way are planned to continue over a long period, there are naturally not many results to be reported upon at this time. The scope of the work is already too large to be successfully carried on with the present means and facilities at hand, nevertheless there are urgent calls for extension in many lines.

The work carried on at the station consists mainly of testing the adaptability of economic fruits; introducing and testing new varieties; selecting superior varieties found on the island; methods of propagation, planting, and fertilization; experiments in shipping fruit to distant markets, and the distribution of seeds and plants of varieties which in the station trials give promising results. As there has been no skilled help available and only the labor of four peons^a allotted for this work, it is obvious that in order to reach results in some lines other subjects can receive but cursory attention. The work enumerated above is supplemented by experiments conducted in various places on the island in cooperation with progressive planters.

The following plants under investigation have yielded results worth recording:

PINEAPPLES.

All the varieties of pineapple under experiment have fruited this year, producing a number of interesting types, all of which will have to be tried further before specific recommendations can be made. The Ruby, a variety from Jamaica, is the most promising of all the less-known kinds tried. The Variegated Lajas, a variety found by the writer in a field near Lajas, has produced fruit this year. This is a strikingly handsome plant, the leaves being variegated and of a much brighter hue than the Variegated Cayenne. The variegation is, however, not in the plant alone, but also in the fruit, making it very valuable for decorative purposes, while the quality is equal to that of the ordinary Cabezona. While this is the only new variety given a name, there are a number of others under observation. Pineapples here are not readily classified because of the great local variation. We have as yet only four named varieties, but there are many distinct types which are now being collected for the purpose of naming, if

^a Common unskilled laborers are generally known as peons in Porto Rico.

they should prove to be stable. Names can not generally be relied upon here, but that is common to all of the varieties in the West Indies; for instance, here the Cabezona of Lajas is different from the Cabezona of Bayamon. Plants from here sent to Dominica were on fruiting classified with the Bullhead variety of that island.^a But the Bullhead as received from Jamaica is very different from the Cabezona. The Pan de Azucar, sent from here to Dominica, is described as being the same as Black Antigua, but plants here received from Antigua under that name are quite distinct from our Pan de Azucar.

Experiments in methods of planting, amount of fertilizer, and most favorable time of applying are under way, but not far enough advanced to report upon. The most practical side of that work is being studied in large fields in cooperation with planters. From the thorough studies by the Florida Experiment Station in fertilizing it seems to be well established what the plant needs.^b Here the soils are very different, and it is of immediate importance to the individual grower to find out how much fertilizer he can economically apply and when to apply it. The influence of soil and fertilizer on the quality of the fruit is also being studied.

For years it has been generally believed that the Cabezona pineapple could not be successfully shipped from here to the States. Shipments have been made every year for a number of years, and while they were often more or less successful, the results were oftener negative. This seems to have been caused by three things—rough handling, bad packing, and wet seasons. The past season was favorable for shipping, and pines packed in the field, carried in ox carts to the train, and on the train to the seaport, and not unpacked before reaching New York two weeks later, were in fairly good condition upon reaching destination. That the percentage of rot can be minimized was thoroughly demonstrated in several experiments at this station. On March 24 two barrels, each containing 15 pines, were shipped to a New York commission house. Of these 3 per cent were spoiled; the rest were sold at 50 cents apiece. On May 14 nine crates and 3 barrels, containing in all 141 pines, were shipped to New York. Of these from 8 to 9 per cent were lost and the rest were sold at 30 cents apiece for the barrel-packed pines and 40 cents for the crate-packed, and other experiments gave similar results. Barreled pineapples shipped to Boston and Washington were reported as received in perfect condition. The regulation Red Spanish crates were used this year by firms shipping from Lajas, but they were found to be unsuitable for the Cabezona pine, and experiments were made to

^a See Dominica Station Report, 1904-5.

^b See Florida Experiment Station Bulletins Nos. 50 and 80.

devise a crate of more suitable dimensions. The fancy crate of Florida was tried also and found unsuitable, but a crate measuring 16 inches wide, 14 inches deep, and 30 inches long will hold 8 pines weighing from 6 to 12 pounds, packed crosswise, 4 on each side of the partition. The larger sizes will pack well without the use of excelsior, but for the smaller some excelsior will be necessary on the top. In order to fill out the entire width of the crate the fruit stalk may be cut off longer on the smaller pines and shorter on the larger. It is not good practice to break the Cabezona like the Red Spanish, because the Cabezona belongs to the class of pines the stems of which break off in the fruit, leaving a cavity, and often deep cracks in the flesh, in which decay starts almost at once. If the fruit could be kept long enough after cutting to let the stem dry it would be possible to break it off without injury, and it would be an advantage, because in rough handling the stem is often pressed up into the fruit. But unfortunately this can not be done, as was shown in the lots kept out of every experiment, in which nearly all the fruits were in bad condition, while those shipped were reported perfect. These results also confirm the experiments of former years.

Experiments were also made in dipping the fruit in solutions like ammoniacal copper carbonate and a weak dilution of formalin, as well as dipping the ends of the stems in melted paraffin, but none of these treatments were of any benefit, since when well handled the fruit kept perfectly without treatment. The rough exterior of the pineapple is deceptive, many people thinking that it does not need to be handled as carefully as fruits with a smooth skin. This is, however, a great mistake. Bruises are readily caused by scratching, squeezing, or bumping, especially in large, loose-fleshed pines like the Cabezonas.

MANGOES.

More mango trees have been planted in the orchard, and also about 15 acres in another part of the station grounds. (Pl. I, fig. 1.) More inarched plants have been received from the United States Department of Agriculture at Washington, and those received last year are in good condition, although they have made but slow growth. Large trees budded and inarched last year are making very rapid growth and will soon yield considerable budwood. While it has been impossible to devote much time to propagation, all the different methods described by writers on this subject have been tried, and there is no question about the feasibility of propagating the mango here. (Pl. I, fig. 2.) It may be stated that some varieties are much more subject to mango blight than others, which fact should be considered when selecting seeds for a nursery, because trees on which the young shoots and the leaves in all stages are continually killed back make but slow



FIG. 1.—A TYPICAL MANGO TREE IN FULL BEARING.



FIG. 2.—INARCHED MANGOES, 1 YEAR OLD.



FIG. 1.—TRANSPLANTING AVOCADOS WITH A BALL OF EARTH.



FIG. 2.—BANANAS GROWN AS WIND-BREAKS FOR CITRUS FRUITS.



growth and are extremely difficult to bud. This same factor should also be considered in selecting budwood from improved varieties, for although the disease can be kept in check by spraying, it needs no argument to convince a Porto Rican planter that spraying is a very costly and often too costly an operation here. All of the better varieties growing in Trinidad and Martinique have been ordered and may be expected at any time.

AVOCADOS.

The last unoccupied land in the orchard has this year been planted to avocados (Pl. II, fig. 1), some of the better varieties found on the island here being collected and budded in the nursery. Several methods of budding have been tried, and while almost any method is fairly successful on the avocado, the shield bud gives uniformly good results and will probably be largely employed because it is familiar to most growers.

CITRUS FRUITS.

As the list of varieties tested at the station had become more than 100, it was found necessary to take out a large number of the citrus trees planted in the fall of 1903. These were planted on the plan of 12 of each variety, which is now reduced to 3 or, in some cases, 5. In planting trees the old method as described in last year's report has been used, which, of course, necessitated more work in the way of spraying for scale insects and other insect pests than could be given with the amount of help allotted, and while most of them would have made trees in time, it was one of the cases where it was cheaper to pull the trees up and replant. The new trees are making good growth and are not being injured by high winds, as there is a row of bananas planted between the rows of orange trees (Pl. II, fig. 2); neither is the foliage being injured by leaf-eating insects, as the soil is constantly cultivated and no weeds left to harbor these pests. Scale insects will, of course, have to be fought, because there are old trees left to infest the new ones; but under the improved conditions it is hoped that the fungi which destroy scale insects will be able to nearly keep them in check.

Most of the varieties first planted are fruiting this year. On account of the poor condition of the trees the fruit is, of course, not of good quality, but it gives some indication of what may be expected. The two varieties of navels, Thompson and Washington, were last year suspected of not being true to name, which is fully confirmed. Some of the Asiatic varieties received from the United States Department of Agriculture are also fruiting, but it is yet too early to judge of the quality. Some very desirable local varieties have been found,

of which two are worthy of special mention. One entirely seedless, found near Mayaguez, is a very promising orange, and one perfect navel, also entirely seedless, was found near Penuelas and budded at the station under the name of Penuelas Navel.

Extensive fertilizer experiments are being conducted in cooperation with planters. One series is for the purpose of showing how much fertilizer can economically be applied to a tree at a certain age and a certain size in a certain soil. These experiments are open to any planter on the island, the horticulturist furnishing the plans and keeping notes on the experiments, while the planter furnishes any brand of fertilizer which he may select, provided the formula is suitable, applying it and cultivating the trees in the usual manner. The practical result of this is obvious, if trees at a certain age produce a certain amount of growth and fruit with an application of 15 pounds fertilizer, while the plats receiving 10, 20, or 30 pounds per tree behave differently, the results will indicate which amount is the most economical to apply.

Another series of experiments is expected to show which are the best forms and amounts of the different fertilizer ingredients for the production and growth of fruit. These experiments are conducted on four different places widely apart, each experiment consisting of 9 to 14 plats of 25 trees each. The different forms of nitrogen, potash, and phosphoric acid are being used and mixed according to formulas which have been found suitable in other countries.

Most of the oranges produced in Porto Rico come from the mountain districts, where the trees are neither cultivated nor fertilized. While the fruit is often of very good quality, a great portion of it is not very firm and does not ship well. Experiments are now under way in which such trees are being fertilized and cultivated, and in some places with the special object to show the influence of potash on the shipping quality of the fruit.

Although the results of these experiments will not be available for a long time, they are of immediate value in an educational way, as they give an impetus to independent thinking and experimenting.

CACAO.

Some of the varieties of cacao imported from Trinidad and planted in 1903 are now fruiting, but it is difficult to secure sound fruit on account of the pod disease, which it has been impossible to keep in check for lack of available labor for spraying. If this disease can be kept in check without too great expense there seems no reason why cacao should not be grown here more extensively. The problem to be solved is to determine if picking and burning the diseased pods and spraying can be done so as to make a profit under present conditions.

GRAPES.

Many varieties of grapes are being tried here and others have been observed in other parts of the island, and the following facts may be noted: Phylloxera seems to be absent, but mildew attacks all varieties. Some varieties seem much more resistant than others and should therefore be selected and planted in locations to which they are adapted. The question of selecting varieties for localities is usually lost sight of. If a variety succeeds well in the cool, moist mountain districts, it could not reasonably be expected to succeed in the hot, dry plains near the seacoast. With well-adapted table varieties and judicious spraying, grape growing could no doubt be made profitable. It must not be forgotten, however, that local experience is necessary in order to succeed. The experienced grape grower from California or France would have to unlearn some of the theories on pruning, because here the *Vinifera* grape does not conform to rules. After pruning, the canes usually die back, and it is therefore impractical to cut the spur, and even in half-long pruning it is not unusual to lose the whole cane and consequently that year's crop. A system of horizontal overhead trellising with long pruning would seem to be best adapted here.

MISCELLANEOUS NOTES.

The following may be briefly noted at this time:

JACK FRUIT (*Artocarpus integrifolia*) has made very rapid growth, and the trees are all healthy. Seeds will be introduced for distribution as soon as possible.

LOQUAT (*Eriobotrya japonica*) is making a rapid growth in the orchard, and bearing trees, from seeds introduced from Spain, have been noted in the mountains between Yauco and Lares. The fruit in that case was small and of no great value, but judging from the behavior of the trees the improved varieties ought to be introduced at once.

CINNAMON (*Cinnamomum zeylanicum* ?).—The tree in the orchard was this year trimmed and the trimmings stripped. The product is somewhat too bitter and not aromatic enough in the raw state, but it imparts an excellent flavor when used in cooking. As the tree is a very vigorous grower it would seem to be worthy of cultivation, at least for home use.

GUAVA (*Psidium* sp.).—All the varieties in the orchard fruited this year, but unfortunately the mummy disease, which they were not thought to be subject to, has attacked all the varieties; even the sour Guisaro (*Psidium molle*) is not wholly immune, although it is more nearly so than any other variety under trial.

APPLES.—Both the Early Harvest and Red Astrachan have borne fruit this year, which may be considered very fair, as they were not planted until April, 1905. The fruit was of fair quality and not the least diseased. A fungus disease noted on the leaves last year is not doing much damage now.

PEACHES.—The peach trees, which were also planted in April, 1905, are making very good growth and several trees of the Peen-To, Jewel, and Waldo varieties early in the season produced fruit which was of first-class quality.

The KEI APPLE (*Aberia caffra*) and VOA-VANGA (*Vangueria edulis*) and Waldo varieties early in the season produced fruit which was be said about the quality.

SEED AND PLANT DISTRIBUTION.

About 1,000 packages of seeds and plants have been sent out to planters on the island and to correspondents in the United States and abroad. Among the special distributions that were made should be mentioned divi-divi, rozelle, lleren, guava, amatungula (*Carissa arduina*), and downy myrtle (*Myrtus tomentosus*). A large number of requests for plants of various kinds are received throughout the year and in that way the surplus material of many under experiment is being distributed before it is actually tested at the station, as well as a number of well-known economic fruits and shade and flowering plants.

REPORT OF THE ENTOMOLOGIST AND PLANT PATHOLOGIST.

By W. V. TOWER.

The writer was appointed a member of the station staff in the spring of 1906. The work which was taken up had been for a year without anyone in charge, and it was therefore necessary to get the threads together before considering any extended line of investigation. Many trips were made to different plantations for the purpose of learning the needs of the planters and advising with them in regard to methods of combating the various insect and other pests with which they have to contend. Porto Rico is not infested with many of the diseases of plants that have wrought havoc in other countries. This is due partly to isolation and partly to the fact that extended plantings of some of the present economic crops date only from the time of the American occupation, some eight years ago.

DISEASES OF CITRUS FRUITS.

By far the larger part of the oranges shipped from the island are wild fruit. These grow in sheltered valleys or groves of natural forest, where they are protected by shade and from the winds. Upon such trees scale is absent or does not seem to thrive. On the cultivated groves, especially where there is no shade or wind-breaks, scale is increasing in amount, and the battle to keep it in check is becoming more serious every year.

Scab infests nearly all the sour orange nursery stock and in many nurseries it is spreading to the budded trees, especially the grape fruit.

In a recent trip through the orange groves there appeared to be very little foot-rot or gum disease. These diseases, which resemble each other in certain respects, are probably due to physiological disturbances. The best treatment is to thoroughly clean all infested areas and apply a fungicide, being careful not to use a solution which will in time weaken the tree, thus causing its death.

The red or circular scale (*Chrysomphalus ficus*), is becoming rather serious in some of the orange groves. Kerosene emulsion does not seem to kill it, but lately we have found a parasitic fungus which is

likely to hold it in check wherever the conditions are favorable. A sample of this fungus has been sent to the Department of Agriculture at Washington for determination.

The purple scale (*Lepidosaphes beckii*) is the most serious pest to the orange growers. This insect has been reported in all the groves in the Bayamon district, and on recent trips to Ponce, Yauco, and Penuelas it was found established in planted groves on the seacoast plains, but was not causing any serious trouble, as it seems to be held in check by fungi. In the mountain districts where no budded trees have been introduced the purple scale has not been found.

In the planted groves various soaps, kerosene, and crude oil emulsions, and resin and potash washes are being used. In inspecting the groves it is readily seen that these sprays are not giving satisfactory results. Experiments are now being carried on in the station grove, as well as in cooperation with planters, testing various insecticides and fungicides.

Lime and sulphur (25 pounds quicklime, 25 pounds flowers of sulphur, and 75 gallons of water) is giving promising results and does not injure the foliage, except occasionally very tender growth. One advantage of this mixture is that the tree appears white after spraying, thus showing just where the spray has touched. Of course it would not be well to use it on nearly ripe fruit, as that would necessitate washing. Hydrocyanic acid gas has been tried, but from the limited experiments it is too early to draw any conclusions. In many of the groves where the natural conditions are favorable the scale is held in check by parasitic fungi. Experiments are now under way to introduce fungi where they are not present. Fungi develop in localities where the prevailing winds are broken by wind-breaks, and it is well recognized that unless shelter from the winds is present it will be necessary to provide wind-breaks by setting out such plants as are best suited to the locality. In heavy soils bananas are being used extensively, while in some of the lighter soils the pigeon pea is giving good results.

The "cuculo," or May beetle (*Lachnosterna* sp.), and the orange leaf-weevil (*Diaprepes spengleri*) are not abundant in orange groves which have been under clean culture for at least one season. In some of the new groves which have been planted in cleared pasture lands the beetles are very disastrous. Hand picking is often practiced, but excellent results have been observed by spraying with arsenate of lead.

The brown or hemispherical scale (*Saissetia hemispharica*) is at present not causing any trouble. In some of the orange groves and coffee plantations there has been observed a fungus which seems to be doing good in checking this scale.

The West Indian peach scale (*Diaspis pentagona*) is very abundant all over the island, infesting peach, plum, mulberry, papaw, castor bean, and other plants. This is a very troublesome pest, as it does not readily yield to sprays unless strong enough to injure the foliage of the host plant.

PINEAPPLE DISEASES.

The pineapple in Porto Rico is comparatively free from diseases or insect pests. During the last year several million plants have been set, the slips coming from Florida and Cuba. From the way the industry is growing and the many sources from which slips are brought into the island, we will no doubt be troubled with some serious diseases or pests in the future.

A grower who has been planting the crowns from the fruit used at a pineapple cannery has had some trouble with the plants rotting soon after being set. It was found advisable to allow these crowns to dry some eight or ten days before planting. After such treatment the losses were reduced very materially. The trouble is first noticed by a rotting of the lower leaves and underground parts, later on extending to the center leaves, which usually remain green for some time after the roots and lower parts are entirely decayed. The exact nature of the trouble is being worked out, but it is not probable that it is a specific disease of this plant.

BANANA DISEASES.

A number of diseased banana stalks have been sent in to the station from some of the coffee plantations where bananas are used for shade. The same disease has also been found at the station, and judging from the damage it may become a serious problem. The infection seems to start from the soil and is probably of bacteriological origin. Upon examining the trunk disease-darkened areas were found which extended from the base of the plant to the apex. Several plant cells which were broken gave off a very disagreeable odor. A similar disease has been reported from some of the Leeward Islands and is being studied by the British stations.

PINEAPPLE INSECTS.

Mealy bugs, attended by ants, in certain localities are causing some damage to pineapples. The ants build galleries of sand in the crown, thus retarding the growth of the plant. Resin wash has been advised and used with good results. Brown ants are not causing any serious trouble in the orange groves which are kept in thorough cultivation,

but on a recent trip the writer found one grove in which pines were planted between the rows, and here the ants were eating the young foliage of the orange trees.

COFFEE INSECTS.

The coffee leaf-miner (*Leucoptera coffeella*) is causing a considerable number of leaves to fall in some plantations. The writer has observed spots where the trees were almost denuded. The parasites do not seem to be holding the insects in check, as they were reported as doing in the previous report.

The coffee leaf-weevil (*Lachnopus* sp.) has been sent to the station from plantations in the neighborhood of Arecibo. The adult insect feeds upon the leaves, reducing the leaf surface at the time when the fruit is setting. Hand picking is practiced with apparent success. This work is usually done by women and boys, receiving so much per quart for picking.

Inga laurina and *Inga vera* are used extensively as coffee shade. On a recent trip into the mountains we found that many of these trees are killed (especially in certain areas) by a very small boring beetle (*Xyleborus* sp.), which is similar to the one that infests the cocoanut palm. On examining the wood, we found it was literally honeycombed. This insect is being studied, and until more is known concerning its life history we are recommending the washing of the trunks with whitewash and carbolic acid. This mixture has been used successfully as an expellant.

SUGAR-CANE PESTS.

The diseases and insects of sugar cane are not causing the planters any serious trouble. There are, however, a number of borers which will in the future cause serious trouble, as cane is being planted on the same land year after year. This constant planting tends to increase disease. Experiments are now under way to determine the best methods for combating these insects. The insect that is causing the most damage to cane is the large borer, *Diatrea saccharalis*. In planting new fields of cane planters are advised to soak their seed for twenty-four hours in lime water in order to kill all borers they may contain. Some excellent results have been obtained by this method in reducing the number of insects, even on land that has already been infested. The canes that are to be planted are placed in a tub or tank, water turned on, and several shovels of lime thrown on top. This is allowed to stand twenty-four hours, when the canes are taken out and planted. Not only is the borer destroyed, but in comparative experiments made at the station seed so treated sprouted quicker and the number of sprouts sent up was greater.

REPORT OF THE COFFEE EXPERT.

By J. W. VAN LEENHOFF.

There is an improved condition among the coffee growers as far as production is concerned. This has come about by recovery from the results of the severe storm of 1899 and also from the fact that better methods of tillage are being followed on many plantations. There is a very heavy crop on the trees in nearly all sections of the island this year which will materially help the coffee planters. Prices remain about stationary, and most of the product is still sold in France, Spain, and Cuba. Although efforts are continually being made to influence the American taste to the liking of Porto Rican coffee very little progress has been attained.

EXPERIMENTAL PLANTINGS.

The work of the experimental tracts, except for the beginning of grafting in the new coffee and for some fertilizer experiments in both the old and new coffee, has been restricted to the care of the plantings in accordance with experiments outlined in previous reports (Pl. III, fig. 1). Some few varieties from other countries have been added to the collection. Through the kindness of Mr. Moy, French consul to Porto Rico, the French Government has sent the station a collection of coffee plants from the colonial agricultural establishment at Nogent-sur-Marne, which is of great interest and probable value in the work. There have also been received from Mr. George Loutrel Lucas, of Jamaica, some seeds of the famous Blue Mountain coffee of that island. These, added to the Javas and other coffees previously received, make a very interesting collection of the best coffees of the world. The Philippine and Hawaiian coffees that have come into bearing are no doubt similar in flavor to the Porto Rican coffee and seem to have no advantage over it. Ceylon coffees that have ripened are superior in flavor, and from trials made in the cup it is probable they will be a valuable introduction in our coffee plantations.

The object of securing the best coffees from various countries of the world is not for the purpose of having a large collection of varieties, but for the purpose of testing these with a view of growing those coffees that bring the highest prices in the markets of the world. The soil, altitude, and climate of Porto Rico seem to be well adapted to the growing of coffee, and as far as our experiments indicate, there seems no reason why Porto Rico can not grow the very finest berries, not only in point of appearance, but in flavor and aroma. If after testing these varieties they are found inferior to the native coffee, they will be discarded and destroyed. If, on the contrary,

they prove superior to the coffee already grown in the island, it is the purpose of the experiment station to distribute them as rapidly as possible among our planters, with a view to their early introduction in a commercial way. If Porto Rico coffees bring 10 cents per pound in the markets and other coffees bring 20 cents, then the first duty is to learn the secret of the better production and follow it as quickly as possible. If the market demands a certain flavor and will pay the highest prices for the berries that carry it, then we should, above everything else, produce that coffee.

While seeking to produce coffee of the highest quality, effort should also be made to increase the yields. The average production per tree and per acre is far below that of some other coffee-producing countries. (Pl. III, fig. 2.) The reason for this lies primarily in the soil, and effort should be made to remedy this defect to the end that the present production per unit may at least be doubled. With this object in view the experiment station is carrying out a number of series of experiments in fertilizing coffee trees. Various mixtures of fertilizers are being employed and in different forms; also experiments are under way using pulp from the coffee mills and also in using the deposits of bat guano found in many of the caves in Porto Rico. A number of plans have been outlined for different planters for carrying out fertilizer experiments for themselves. Some of these are comparisons of commercial fertilizers with a home-made fertilizer, made of bat guano and potash salts. Some of the guanos found in the caves run from 2 to 3 per cent and over in nitrogen and 10 per cent in phosphoric acid. With the addition of potash these make complete fertilizers that are richer in the elements of fertility than some of the commercial fertilizers sold on the island. On many of the plantations these bat guanos are found ready at hand.

Coffee blossoms in Porto Rico at different periods, according to altitude and locality. On the north side of the central range of mountains, which runs from east to west and south of the middle line of the island, coffee blossoms a month or more earlier. The period on the experiment station tract ranges from February to May, consisting of one principal blossoming and followed by one or more smaller blossomings. The principal blossoming decides whether we shall have a good, average, or poor crop. About seven months after the blossoming the berries ripen. The harvest begins in September and lasts until January, during which time about ten pickings, at intervals, are made.

MALTING OF COFFEE.

The harvest time of coffee in Porto Rico falls in the rainy season. September to December, and several of the smaller planters, lacking artificial means of drying their coffee, are entirely dependent on the



FIG. 1.—COFFEE SUBSTATION, LA CARMELITA.



FIG. 2.—A NATIVE COFFEE PLANTATION AND RESIDENCE.

sun. When the sun does shine during several days in succession, as often happens during the rainy season, the wet coffee begins to sprout, and through lack of proper handling rots, developing a very bad smell. With a view of determining how long wet coffee could be kept without damage to quality and also to determine if the sprouting process influenced the flavor, the following experiments were made:

December 30, 1905, fermented and recently washed coffee in the parchment skin was put in a heap on a cement floor in a basement very much resembling a malt cellar. The heap was turned daily.

January 23, 1906, the first grains began to sprout, and the heap was spread out about a foot deep and turned daily.

February 23, 1906, all the grains had sprouted, and the sprouts had about the same length as the length of the grain. The whole was now dried in the ordinary way and hulled.

During the sprouting process, and before turning, the upper layer, having become dry, was sprayed with water of ordinary temperature. The sprouting process was very irregular, and as soon as some grains had developed sprouts of the length of the grain, these were taken out and dried. Not the least bad smell was observed during the whole process, lasting fifty-six days.

Of the coffee prepared thus samples were sent to different consumers, roasters, and dealers, and their opinion requested. Messrs. F. A. Cauchois & Co., of New York, wrote as follows: "Your 4-pound sample of coffee was received to-day, and I roasted part of it and found it a fine-looking and nice-tasting coffee." Dr. Walter H. Evans wrote: "I received some time ago a sample of malted coffee. We have tried this and like it very much." And later, "Those of us who have tried the coffee like the improved flavor very much." Other recipients communicated verbally and made similar statements. To the writer personally it seemed that the flavor of the coffee prepared thus was finer, and that the bitter taste so much complained of had disappeared.

The result of the experiment can be regarded as favorable, as it seems to prove that coffee can be kept in a wet state and allowed to sprout for about two months without damaging the quality. It is to be regretted that lack of instruments did not permit observations of temperature and weights and mechanical and chemical changes. I would recommend that the experiment be repeated with all necessary facilities for observations and comparisons.

DISEASES AND INSECT PESTS.

Leaf weevils (family Otiorhynchidæ) continue to do considerable damage, and are most abundant in the neighborhood of higuerillo trees (*Vitex divaricata*). It seems that they breed with preference on those giant trees, from which they occasionally drop on the coffee

standing underneath, causing a circle of destroyed coffee trees around the higuerillo.

Leaf-miners (*Leucoptera coffeella*), although plentiful, do not seem to be so abundant as last year. Experiments with sulphur mixed with the soil around the roots did not give any result at all. Hand picking had to be abandoned, but the observation of last year that the better the soil the less the plant suffers from attacks of the leaf miner was made use of this year to try fertilizers. A field of heavily attacked trees of a neighboring plantation was selected. It contained 584 three-year-old trees with hardly a leaf left on them, those that were left being filled with the leaf-miner. The whole field presented a barren aspect. Between January 29 and February 1 the trees were fertilized as follows:

Fertilizer experiment against coffee leaf-miner.

Number fertilized.	Stable manure.	Coffee pulp.	Lime.	Nitrate of soda.	Super- phos- phate.	Muriate of potash.
	Pounds.	Pounds.	Pound.	Ounces.	Ounces.	Ounces.
41 trees.....	5	5	0.5	1	1	1
73 trees.....			.5	1	1	1
470 trees.....				1	2	1

Before the application the ground was hoed for about 2 feet around the trunk of the tree and the stable manure and coffee pulp worked in. The fertilizers were used as a top-dressing. On March 13 following 1 ounce of nitrate of soda was again given to each tree.

At the time of writing all the trees had entirely recuperated and had blossomed well, but it remains to be seen whether they will withstand the leaf-miner attacks until harvest.

A fungus disease was observed attacking coffee berries and apparently passing through the parchment, causing circular perforations, into the grain, in which it produced warty excrescences, rendering it valueless. The disease occurred on trees in the shade as well as on those without shade, those attacked suffering severely. On healthy trees the disease was not observed. The diseased spot on fresh berries under the magnifying glass showed distinct fungus growths, white threads, and some mushroom forms of a yellowish color very much like the *Stilbum flavidum*. The disease on the parchment and grains was observed in former years, but not in such abundance. After the blossoms of this year had fallen off, the trees observed last year to be attacked by the disease were sprayed with Bordeaux mixture, three sprayings being given at intervals of two weeks. Up to the present time no disease has been noticed on the sprayed trees.



